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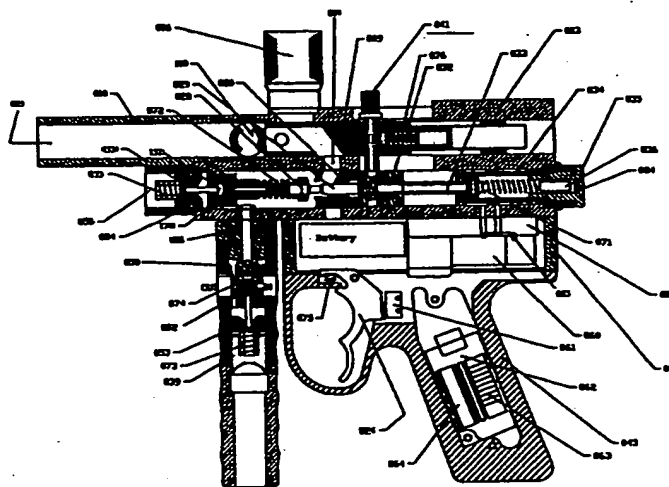
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(54) Title: SPRING-ASSISTED COMPRESSED GAS GUN



(57) Abstract: A compressed gas powered gun having a compressed gas and spring biased slider (33) reciprocally moveable within a pneumatic gas cylinder (34) within the gun; the slider being released by the actuation of the solenoid (60) via electronic signals from a microprocessor triggered by the depression of the gun's trigger (24) by a user. The slider includes a hammer (32) for engaging a horizontally oriented valve stem to release compressed gas from a gas source into the barrel and breech of the gun for propelling a projectile. Recocking of the slider is done by deactuation of the solenoid. A gas control system includes specific faceted angles within the breech to control pressure within the barrel and breech, hence controlling projectile velocity. The valve stem is parallel to the slider.

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## SPRING-ASSISTED COMPRESSED GAS GUN

## DESCRIPTION

BACKGROUND OF THE INVENTIONField of the Invention.

This invention generally relates to compressed gas-powered guns and more specifically to guns for firing marker projectiles such as "paint balls." The use of marking guns is well-known. Within a marking gun, there is employed a projectile which is generally in the shape of a marble. This projectile is constructed of a thin wall which is to readily break upon being propelled against a target. Typical construction for the wall of the projectile would be a gelatin. Within the wall of the projectile is contained a quantity of a liquid such as a colored paint. A typical color would be red.

Related Art.

Compressed gas powered guns for the firing of projectiles have long been used. Of more recent use, such guns have been made for the firing of spherical and fragile projectiles containing a colored marking fluid, such projectiles commonly being referred to as "paint balls." Such guns are typified by other inventions of the Inventor, namely U.S. Patent No. 5,497,758, showing a compressed gas powered gun. Problems associated with such guns include: dangerously high pressure build-up within the gun potentially damaging the gun and endangering the user; a mechanical limitation on the cycle time of the firing mechanism limiting the firing rate of the gun; excessive shock and recoil resulting from reciprocal movement of the hammer into the firing and recocked positions.

SUMMARY OF THE INVENTION

The present invention is a compressed gas powered gun for the firing of projectiles. The invented gun has many improvements over the prior art including: the use of improved gas pressure routing allowing for operation at lower pressures with no decrease in firing rate, efficiency, trajectory, or range; the addition of a pressure regulating system which prevents the pressure from building to dangerous levels; the use of a hammer dampener system, and the use of a spring

assisted pneumatic firing system which decreases the mechanical limitation on the cycle time of the firing mechanism thereby increasing firing rate. The structure of the present invention provides for embodiments which include: the use of specific faceted angles within a portion of the breech through which the gas is routed as it expands; the use of high pressure and low pressure check valves within the high pressure and low pressure regulators, respectively, which shut down the flow of gas if gas pressure climbs above a pre-determined level; the use a spring and pressurized gas to dampen the forward motion of the hammer, and an o-ring to dampen the rearward motion of the hammer; and the use of a spring biased slider to more efficiently bias the slider, and thus the hammer, into the firing position.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side, schematic view of one embodiment of the present invention showing the invented gun in the cocked position.

Figure 2 is a side, schematic view of another embodiment of the present invention showing the invented gun in the firing position.

Figure 3 is a side, schematic view of pneumatic gas cylinder assembly.

Figure 4 is a side schematic view of a section of the pressure routing system.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, an embodiment to be preferred of a compressed gas powered gun, made according to the present invention, is disclosed. Gun includes, generally, a grip 45; a body, including an upper main housing 3 and a lower main housing 1; a barrel 10; a bore 5; a bolt 9 within a breech; a hammer chamber 2; a pneumatic gas cylinder 34; a slider 33; and a trigger 24. Throughout the Description, the term "forward" indicates being towards the outer, open, free end of the barrel 10 extending from the upper main housing 3 of the gun. "Rearward" indicates the opposite direction of "forward".

As shown in Figures 1 and 2, a projectile feed tube 6 opens into the barrel 10, said projectile feed tube 6 for supplying the barrel 10 with projectiles 100, which are preferably spherical in form and contain a marking fluid. A conventional projectile retention lever (not shown) biased by a spring allows only one projectile 100 to enter the barrel 10 at a time.

Generally rearward and below the barrel 10, the hammer chamber 2 holds a hammer 32 which is integrally attached to the forward end of the slider 33. Slider 33 is horizontally and reciprocally moveable within gas cylinder 34 from a cocked position, as shown in Figure 1, to a firing position, as shown in Figure 2, through the use of spring bias and compressed gas. The slider 33 is cocked by means of an electronic solenoid actuated 4-way valve 65 located in the lower main housing 1. A manifold 8 connects the 4-way valve 65 to the pneumatic gas cylinder 34. When biased to the firing position, the slider 33 forces the hammer 32 to engage a valve stem 29. A link pin 41, circular in cross-section, extends between and connects the bolt 9 to the hammer 32.

The bolt 9 is held within the gun through use of the link pin 41, attached to the hammer 32. Removal of the link pin 41 allows the bolt 9 to be removed from the gun. This may be done for routine maintenance. The link pin 41 is held in place by means of a bolt retention spring 76.

Within the pneumatic gas cylinder 34, a main compression spring 71 extends between the slider 33 and an end-cap 35 which is attached at the rearward end of the gas cylinder 34. A main spring guide 36 rests within the cylinder 34 between the slider 33 and the end-cap 35, said guide 36 for receiving the compressed main compression spring 71. Slider 33 is biased forward to a firing position by the main compression spring 71 and compressed gas (not shown). The shock of the hammer 32 is dampened both as the hammer 32 moves forward into the firing position and as it returns to a recocked position. The forward motion of the hammer 32 is dampened by both the valve spring 72 and the compressed gas surrounding the valve spring 72. The rearward motion of the hammer 32 is dampened by an o-ring 84 located in gas cylinder 34, between the guide 36 and the end-cap 35.

Releasably holding the slider 33 in a cocked position is an electronic solenoid activated 4-way valve 65. The electronic solenoid 60 is actuated through a micro-switch 61 located rearward of the trigger 24. Pulling on the trigger 24 sends an electronic signal to a CPU (microprocessor) 64 located in the grip 45. This CPU 64 by means of software determines which of a number of dual in-line package (hereinafter 'dip') switches 63 have been switched on or off, thereby determining the firing rate and mode selected by the user. The CPU 64 then, based on firing rate and mode, actuates the solenoid 60, causing the 4-way valve 65 to shift, causing the slider 33 to be propelled forward under the bias of spring pressure and compressed gas. The CPU 64 then deactuates the solenoid 60 causing the 4-way valve 65 to shift, and compressed gas forces the main compression

spring 71 to compress thereby recocking the gun. A trigger spring 75 forces the trigger 24 back to its original position.

Compressed gas for propelling projectile 100 and for moving the slider 33 to a firing position is provided from a canister or cylinder (not shown), which may be attached directly to gun or may be attached to the person operating the gun. The gas is fed through a high pressure (hereinafter "HP") regulator 50, and then through a passageway through a high pressure adaptor 51 to a cavity defined by lower main housing of body 1. The high pressure regulator 50 reduces the gas pressure from over 500 pounds per square inch (hereinafter "p.p.s.i.") to around (hereinafter "~") 250 p.p.s.i. The HP regulator comprises a HP adjustment screw 39, a HP regulator spring 73, a HP regulator piston 53, a HP regulator cup 52, and a HP regulator cup spring 74. This high pressure regulator 50 further comprises a safety feature forcibly closing the high pressure regulator cup 52 when over 800 or so p.p.s.i. is applied. This closure protects the inner workings of the gun and protects the gun's operator.

Contained within the cavity are two valve means. The first valve means is for propelling the slider 33. The second valve means is for supplying gas to propel the projectile 100. The first valve means further comprises a low pressure (hereinafter "LP") regulator 54 for reducing pneumatic gas pressure from the ~250 p.p.s.i. supplied to ~85 p.p.s.i. This pressurized gas is then channeled to the gas cylinder 34 for the propulsion of the slider 33 upon actuation of the trigger 24. The LP regulator comprises a LP adjustment screw 56, a LP regulator spring 173, a LP regulator piston 153, a LP regulator cup 152, and a LP regulator cup spring 174. This low pressure regulator 54 further comprises a safety feature forcibly closing the low pressure regulator cup 152 when over 300 or so p.p.s.i. is applied. This closure protects the inner workings of the gun and protects the gun's operator.

The second valve means includes a horizontally oriented valve stem 29 which is horizontally and reciprocally moveable within a valve stem guide 30. Valve stem 29 is provided with a valve cup 28 which engages a valve spring 72, biasing the valve cup 28 to a seated position on the valve stem guide 30 to prevent flow of compressed gas from cavity into the barrel 10.

It has also been found that projectile 100 velocity can be controlled through the use of specifically angled surfaces within the gas passage 4, through which the gas expands as it enters the barrel 10. The gas passage 4 is defined by the continuous conduit extending from the valve cup 28,

through the valve stem guide 30 and the forward portion of the bolt 9. When the valve cup 28 is biased to an open/firing position, the gas is allowed to expand through the conduit extending through the valve stem guide 30 and the bolt 9. The inner surfaces of the valve stem guide 30 and the bolt 9 are machined to form a conduit having a specific angle through which the gas expands. It has been found by the inventor that  $23 \text{ degrees} \pm 5 \text{ degrees}$  is the optimal angle for these surfaces. Use of such angular surfaces allows the present invention to fire a projectile 100 using less than one half the p.p.s.i. of traditional guns at the same firing rate as those guns, without jeopardizing the efficiency, trajectory or range of the projectile 100. By funneling the gas as it expands through the use of such angular surfaces, resistance is reduced, thereby allowing firing at a high firing rate to be done with lower p.s.i.

The gun further comprises an electronic system comprising a circuit board 62 containing a microprocessor (CPU) 64, and a series of dip switches 63 which can be set to control the firing rate and mode of the gun. The gun is further programable so as to allow firing rate and mode limits to be forcibly set.

Sequential action of the gun may be seen to advantage. A projectile 100 is in place within the barrel 10. A second projectile (not shown) is held in place above the barrel 10 and within feed tube 6 by the projectile retention lever (not shown). Slider 33 is in the cocked position via the solenoid 60. It is assumed that the high pressure regulator 50 is in fluid communication with an external compressed gas source (not shown) to fill cavity with compressed gas.

The trigger 24 is then pulled, a microswitch 61 is activated sending a signal to the CPU 64 that the user wishes to fire the gun. The CPU 64 then determines which dip switches 63 have been preset by the user, thereby determining the firing rate and mode of the gun. Upon determining the firing rate and mode, the CPU 64 then directs the solenoid 60 to act accordingly. The firing rate and mode of the gun are detailed as follows:

DIP Switch settings - Modes - Rate of Fire:

(Note: the following settings are not shown in attached Figures.)

Rate of fire is dependant on the mode and switch settings of the dip switches. Modes are:

1. semi-auto (one single shot per trigger pull),
2. 3 shot (3 shots if the trigger is pulled and not released, with single shot capabilities),

3. 6 shot burst (6 shots if the trigger is pulled and not released, with single shot or any amount between capabilities),

4. Full auto (as long as the trigger is pulled it will cycle).

Mode selection is done via switches #1 and #2. Mode settings using the switches are as follows:

5	#1	#2	
	off	off	Semi mode
	on	off	3 shot mode
	off	on	6 shot burst mode
	on	on	Full auto mode

10

Rate of Fire and timing is as follows:

Dip switch #3 and #4 (registers Solenoid on; times in milliseconds)

	#3	#4	
	off	off	= 06 ms
15	on	off	= 08 ms
	off	on	= 10 ms
	on	on	= 12 ms

Dip switch #5, #6, and #7 (registers Solenoid off (delay before re-cycle); times in milliseconds)

20	#5	#6	#7	
	off	off	off	= 70 ms
	on	off	off	= 80 ms
	off	on	off	= 90 ms
	on	on	off	= 100 ms
25	off	off	on	= 110 ms
	on	off	on	= 120 ms
	off	on	on	= 130 ms
	on	on	on	= 140 ms

30 Dip switch 8: display cycle rate, mode and shot count.

on = display yes

off = display no.

As the solenoid 60 is deactuated, the gun is cocked. As the solenoid 60 is actuated,  
5 compressed gas and the main compression spring 71 move the hammer 32 and slider 33 to the firing position, by moving the slider 33 forward with hammer 32 slidably engaging the valve stem 29. The hammer 32 engages valve stem 29, thereby unseating the valve cup 28, causing the release of compressed gas into the gas passage 4, thereby propelling the projectile 100 through the barrel 10.

10 The slider 33 has moved forward into the firing position forcing the hammer 32 to engage tip of valve stem 29. Simultaneously, valve stem 29 is forced inwardly against the bias of valve spring 72 to unseat the valve cup 28 from its seat, thus allowing the compressed gas to enter the barrel 10. Gas entering the barrel 10 progresses through conduit formed by angular surfaces of the valve stem guide 30 and the forward portion of the bolt 9, forcing projectile 100, which has a  
15 diameter approximating that of the bore 5 of the barrel 10, out of the barrel 10 at a velocity dependent upon the gas pressure within the barrel 10 which is controlled by high pressure regulator 50. The solenoid 60 is then deactuated to force the slider 33 and hence hammer 32 back to the recocked position. Valve stem 29 is again biased into its seated position by valve spring 72 to prevent further flow of compressed gas into the barrel 10. Upon deactuation of solenoid 60, the  
20 slider 33 and hence the link pin 41 and bolt 9 are forced back to the recocked position. As the bolt 9 moves to the recocked position, the projectile retention lever (not shown) allows a new projectile 100 to enter barrel 10 and again holds a next projectile (not shown) in place under bias of spring.

Having thus described in detail a preferred embodiment of the present invention, it is to be appreciated and will be apparent to those skilled in the art that many physical changes could be  
25 made in the apparatus without altering the inventive concepts and principles embodied therein. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

30 What is claimed is:



**Claims:****1. A compressed gas gun comprising:**

a barrel, said barrel having a bore;

a breech;

a reciprocating piston;

a trigger assembly;

a grip;

a pressurized gas supply;

a gas chamber;

a projectile feed tube;

a projectile propelling mechanism, operation of said trigger assembly causes activation of said projectile propelling mechanism resulting in discharging of a projectile from said bore of said barrel,

the improvements in the present invention comprising:

a pneumatic gas cylinder assembly further comprising:

a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end; a spring guide located within said cylinder; a spring connecting said piston and said guide; a valve means for connecting said cylinder to said gas supply; said cylinder, piston, guide and spring being axially aligned;

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator check valve which forcibly closes when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch;

a low pressure regulating mechanism further comprising:

a low pressure regulator check valve which forcibly closes when said low pressure regulating mechanism is exposed to pressures above about 300 pounds per square inch;

an end-cap attached to said rear end of said cylinder, further comprising:

an o-ring located between said end-cap and said guide, said o-ring for dampening a recoil effect from said reciprocating piston.

2. A compressed gas gun comprising:

a barrel, said barrel having a bore;

a breech;

a reciprocating piston;

a trigger assembly;

a grip;

a pressurized gas supply;

a gas chamber;

a projectile feed tube;

a projectile propelling mechanism, operation of said trigger assembly causes activation of said projectile propelling mechanism resulting in discharging of a projectile from said bore of said barrel,

the improvements in the present invention comprising:

a pneumatic gas cylinder assembly further comprising:

a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end; a spring guide located within said cylinder; a spring connecting said piston and said guide; a valve means for connecting said cylinder to said gas supply; said cylinder, piston, guide and spring being axially aligned.

3. A compressed gas gun as in Claim 2, wherein:

said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore.

- 10 4. A compressed gas gun as in Claim 2, wherein:

said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator check valve which forcibly closes when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch.

5. A compressed gas gun as in Claim 2, wherein:

said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator check valve which forcibly closes when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch;

a low pressure regulating mechanism further comprising:

a low pressure regulator check valve which forcibly closes when said low pressure regulating mechanism is exposed to pressures above about 300 pounds per square inch.

10 6. A compressed gas gun comprising:

a barrel, said barrel having a bore;

a breech;

a reciprocating piston;

a trigger assembly;

15 a grip;

a pressurized gas supply;

a gas chamber;

a projectile feed tube mounted on said barrel, said projectile feed tube for supplying the barrel with a projectile to be discharged from the bore of the barrel;

20 a projectile propelling mechanism, operation of said trigger assembly causes activation of said projectile propelling mechanism resulting in discharging of said projectile from said bore of said barrel;

the improvements in the present invention comprising:

a pneumatic gas cylinder assembly further comprising:

25 a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end, said rear end of said cylinder having an end-cap; a spring guide located within said cylinder; a spring connecting said piston and said guide; a valve means for connecting said cylinder to said gas supply; said cylinder, piston, guide and spring being axially aligned;

30

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high pressure regulator cup, and a high pressure regulator check valve which forcibly closes said a high pressure regulator cup when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch;

a low pressure regulating mechanism further comprising:

a low pressure regulator spring, a low pressure regulator piston, a low pressure regulator cup, and a low pressure regulator check valve which forcibly closes said a low pressure regulator cup when said low pressure regulating mechanism is exposed to pressures above about 300 pounds per square inch;

said cylinder assembly further comprising:

an o-ring located between said guide and said end cap, said o-ring for dampening a recoil effect from said reciprocating piston.

7. A compressed gas gun comprising:

a barrel, said barrel having a bore;

a breech;

a reciprocating piston;

a trigger assembly;

a grip;

a pressurized gas supply;

a gas chamber;

a projectile feed tube mounted on said barrel, said projectile feed tube for supplying the barrel with a projectile to be discharged from the bore of the barrel;

a projectile propelling mechanism, operation of said trigger assembly causes activation of said projectile propelling mechanism resulting in discharging of said

projectile from said bore of said barrel;

the improvements in the present invention comprising:

a pneumatic gas cylinder assembly further comprising:

a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end, said rear end of said cylinder having an end-cap; a spring guide located within said cylinder; a spring connecting said piston and said guide; a valve means for connecting said cylinder to said gas supply; said cylinder, piston, guide and spring being axially aligned.

8. A compressed gas gun as in Claim 7, wherein:  
said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore.

9. A compressed gas gun as in Claim 7, wherein:  
said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees

from a horizontal axis of said gas chamber and an angle of about 23 degrees  
 $\pm 5$  degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high  
pressure regulator cup, and a high pressure regulator check valve which  
forcibly closes said a high pressure regulator cup when said high pressure  
regulating mechanism is exposed to pressures above about 800 pounds per  
square inch.

10. A compressed gas gun as in Claim 7, wherein:  
said improvements further comprise:

a gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said  
bore, said angled surfaces forming an angle of about 23 degrees  $\pm 5$  degrees  
from a horizontal axis of said gas chamber and an angle of about 23 degrees  
 $\pm 5$  degrees from a horizontal axis of said bore;

a high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high  
pressure regulator cup, and a high pressure regulator check valve which  
forcibly closes said a high pressure regulator cup when said high pressure  
regulating mechanism is exposed to pressures above about 800 pounds per  
square inch;

a low pressure regulating mechanism further comprising:

a low pressure regulator spring, a low pressure regulator piston, a low  
pressure regulator cup, and a low pressure regulator check valve which  
forcibly closes said a low pressure regulator cup when said low pressure  
regulating mechanism is exposed to pressures above about 300 pounds per  
square inch.

11. A compressed gas gun comprising:

an upper main housing;

a barrel, attached to the upper main housing, said barrel having a bore;

a projectile feed tube mounted on said barrel, said projectile feed tube opening into  
the barrel for supplying the barrel with a projectile to be discharged from the bore of  
the barrel;

a bolt assembly located within the upper main housing generally rearward of the  
barrel, said bolt assembly consisting of a bolt, a link pin, and a bolt retention spring,  
said bolt having a hollow forward portion;

a lower main housing attached to said barrel and said upper main housing generally  
below said upper main housing;

a trigger assembly connected to said lower main housing, said trigger assembly  
being manually operational;

a grip connected to said lower main housing and said trigger assembly generally  
rearward of said trigger assembly;

an electronic solenoid located in said lower main housing generally above said grip,  
said solenoid for actuating a four way valve, said four way valve located in said  
lower main housing generally above said solenoid;

a projectile propelling mechanism connected to said lower main housing and said  
trigger assembly generally forward of said trigger assembly, manual operation of  
said trigger assembly causes activation of said projectile propelling mechanism  
resulting in discharging of said projectile from said bore of said barrel, said  
projectile propelling mechanism comprising:

an exterior pressurized gas cylinder assembly comprising a gas cylinder,  
pressurized gas, and a means for attaching said pressurized gas cylinder  
assembly to said projectile propelling mechanism;

a high pressure regulating mechanism connecting said gas cylinder to said  
lower main housing;

a valve mechanism mounted within said lower housing connecting said high  
pressure regulating mechanism with said bore, said valve mechanism having



5 a gas chamber, a valve stem, a valve cup, and a valve stem guide, said valve mechanism having a gas passage arrangement connecting said high pressure regulating mechanism and said bore, said gas passage arrangement consisting of a conduit through said valve stem guide and said forward portion of said bolt, said valve mechanism having a closed position preventing flow of said gas to said bore, operation of said trigger assembly causing said valve mechanism to move to an open position allowing said gas to flow through said conduit into said bore, causing said projectile located in said bore to be propelled exteriorly of said barrel after which said valve mechanism returns to said closed position;

10 a low pressure regulating mechanism connecting said valve mechanism to said four way valve;

15 a pneumatic gas cylinder assembly comprising a slider, said slider comprising a hammer and a piston, said piston having a forward end and a rearward end, said hammer being attached to said forward end of said piston, said slider being horizontally and reciprocally moveable within said lower main housing, said slider being in fluid communication with said four way valve, said slider being biased to a firing position by actuation of said solenoid, said slider in said firing position engaging said valve stem causing

20 said valve mechanism to move to said open position,

said pneumatic gas cylinder assembly further comprising:

25 a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end, said forward end of said piston remaining exterior to said front end of said cylinder, said rear end of said cylinder having an end-cap, a main spring guide resting between said piston and said end-cap, said main spring guide having a front end and a rear end, a main compression spring connecting said rearward end of said piston and said main spring guide;

said gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

5 said high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high pressure regulator cup, and a high pressure regulator check valve which forcibly closes said a high pressure regulator cup when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch;

10 said low pressure regulating mechanism further comprising:

a low pressure regulator spring, a low pressure regulator piston, a low pressure regulator cup, and a low pressure regulator check valve which forcibly closes said a low pressure regulator cup when said low pressure regulating mechanism is exposed to pressures above about 300 pounds per square inch;

15 said end-cap further comprising:

an o-ring located at the rear end of said main spring guide, said o-ring for dampening a recoil effect from said reciprocating slider.

20 12. A compressed gas gun comprising:

an upper main housing;

a barrel, attached to the upper main housing, said barrel having a bore;

25 a projectile feed tube mounted on said barrel, said projectile feed tube opening into the barrel for supplying the barrel with a projectile to be discharged from the bore of the barrel;

a bolt assembly located within the upper main housing generally rearward of the barrel, said bolt assembly consisting of a bolt, a link pin, and a bolt retention spring, said bolt having a hollow forward portion;

a lower main housing attached to said barrel and said upper main housing generally below said upper main housing;

a trigger assembly connected to said lower main housing, said trigger assembly being manually operational;

5 a grip connected to said lower main housing and said trigger assembly generally rearward of said trigger assembly;

an electronic solenoid located in said lower main housing generally above said grip, said solenoid for actuating a four way valve, said four way valve located in said lower main housing generally above said solenoid;

10 a projectile propelling mechanism connected to said lower main housing and said trigger assembly generally forward of said trigger assembly, manual operation of said trigger assembly causes activation of said projectile propelling mechanism resulting in discharging of said projectile from said bore of said barrel, said projectile propelling mechanism comprising:

15 an exterior pressurized gas cylinder assembly comprising a gas cylinder, pressurized gas, and a means for attaching said pressurized gas cylinder assembly to said projectile propelling mechanism;

a high pressure regulating mechanism connecting said gas cylinder to said lower main housing;

20 a valve mechanism mounted within said lower housing connecting said high pressure regulating mechanism with said bore, said valve mechanism having a gas chamber, a valve stem, a valve cup, and a valve stem guide, said valve mechanism having a gas passage arrangement connecting said high pressure regulating mechanism and said bore, said gas passage arrangement

25 consisting of a conduit through said valve stem guide and said forward portion of said bolt, said valve mechanism having a closed position preventing flow of said gas to said bore, operation of said trigger assembly causing said valve mechanism to move to an open position allowing said gas to flow through said conduit into said bore, causing said projectile located in

said bore to be propelled exteriorly of said barrel after which said valve mechanism returns to said closed position;

a low pressure regulating mechanism connecting said valve mechanism to said four way valve;

5 a pneumatic gas cylinder assembly comprising a slider, said slider comprising a hammer and a piston, said piston having a forward end and a rearward end, said hammer being attached to said forward end of said piston, said slider being horizontally and reciprocally moveable within said lower main housing, said slider being in fluid communication with said four  
10 way valve, said slider being biased to a firing position by actuation of said solenoid, said slider in said firing position engaging said valve stem causing said valve mechanism to move to said open position,

said pneumatic gas cylinder assembly further comprising:

15 a cylinder in which said piston reciprocates horizontally, said cylinder having a front end and a rear end, said forward end of said piston remaining exterior to said front end of said cylinder, said rear end of said cylinder having an end-cap, a main spring guide resting between said piston and said end-cap, said main spring guide having a front end and a rear end, a main  
20 compression spring connecting said rearward end of said piston and said main spring guide.

13. A compressed gas gun as in Claim 12, wherein:

said gas passage arrangement further comprising:

25 angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore.

14. A compressed gas gun as in Claim 12, wherein:

said gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

said high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high pressure regulator cup, and a high pressure regulator check valve which forcibly closes said a high pressure regulator cup when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch.

15. A compressed gas gun as in Claim 12, wherein:

said gas passage arrangement further comprising:

angled surfaces forming a conduit connecting said gas chamber with said bore, said angled surfaces forming an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said gas chamber and an angle of about 23 degrees  $\pm$  5 degrees from a horizontal axis of said bore;

said high pressure regulating mechanism further comprising:

a high pressure regulator spring, a high pressure regulator piston, a high pressure regulator cup, and a high pressure regulator check valve which forcibly closes said a high pressure regulator cup when said high pressure regulating mechanism is exposed to pressures above about 800 pounds per square inch;

said low pressure regulating mechanism further comprising:

a low pressure regulator spring, a low pressure regulator piston, a low pressure regulator cup, and a low pressure regulator check valve which forcibly closes said a low pressure regulator cup when said low pressure

regulating mechanism is exposed to pressures above about 300 pounds per square inch.

- 5      16.    A compressed gas gun as in Claim 2, wherein:  
said improvements further comprise:
- a high pressure regulating mechanism further comprising:
- a high pressure regulator check valve which forcibly closes when said high  
         pressure regulating mechanism is exposed to pressures above about 800  
10          pounds per square inch;
- a low pressure regulating mechanism further comprising:
- a low pressure regulator check valve which forcibly closes when said low  
         pressure regulating mechanism is exposed to pressures above about 300  
         pounds per square inch;
- 15          an end-cap attached to an end of a cylinder, further comprising:
- a guide within said cylinder, an o-ring located between said end-cap and  
         said guide, said o-ring for dampening a recoil effect from said reciprocating  
         piston.
- 20
17.    A compressed gas gun as in Claim 2, wherein:  
said improvements further comprise:
- an end-cap attached to an end of a cylinder, further comprising:
- a guide within said cylinder, an o-ring located between said end-cap and  
25          said guide, said o-ring for dampening a recoil effect from said reciprocating  
         piston.

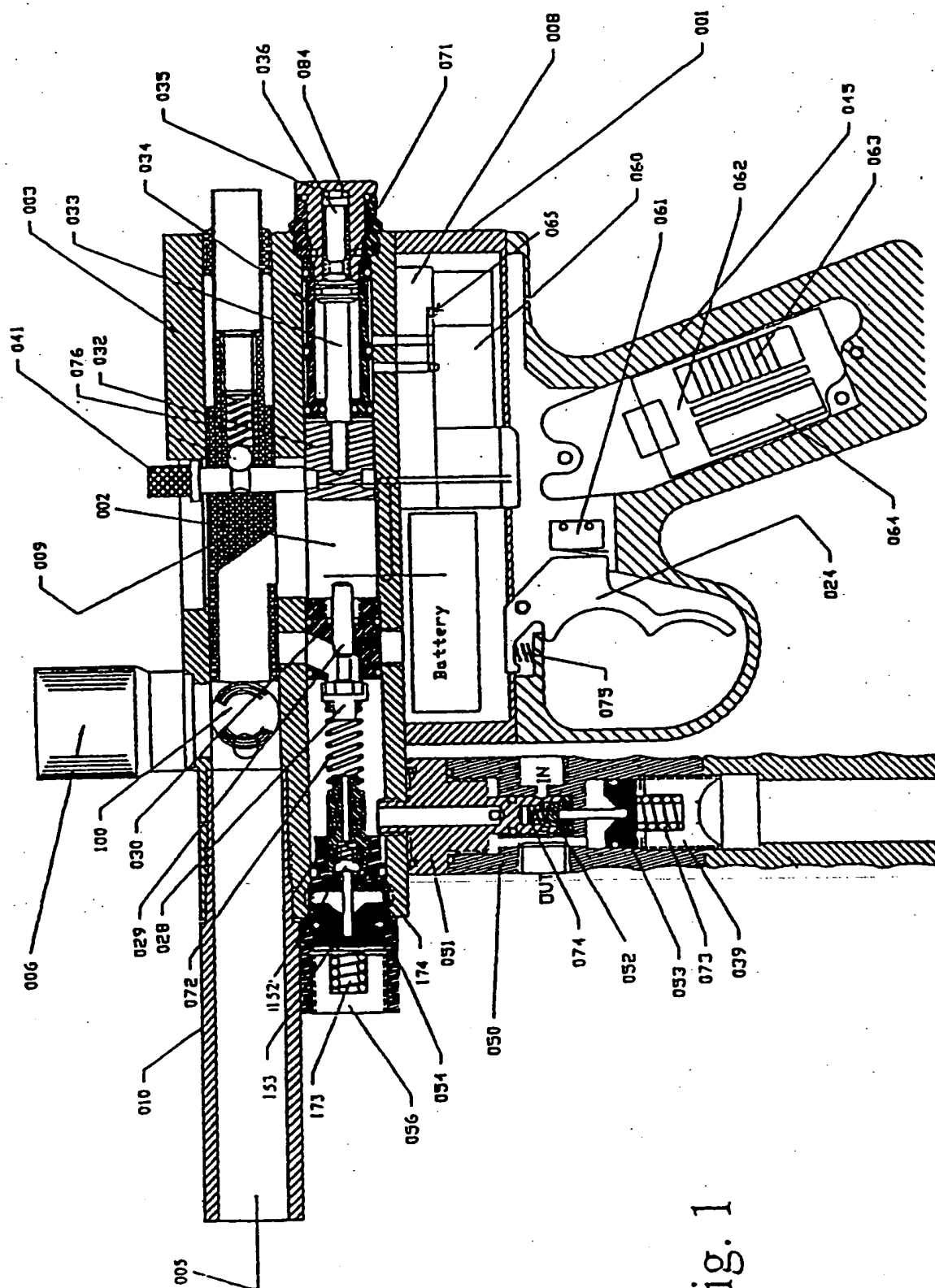


Fig. 1

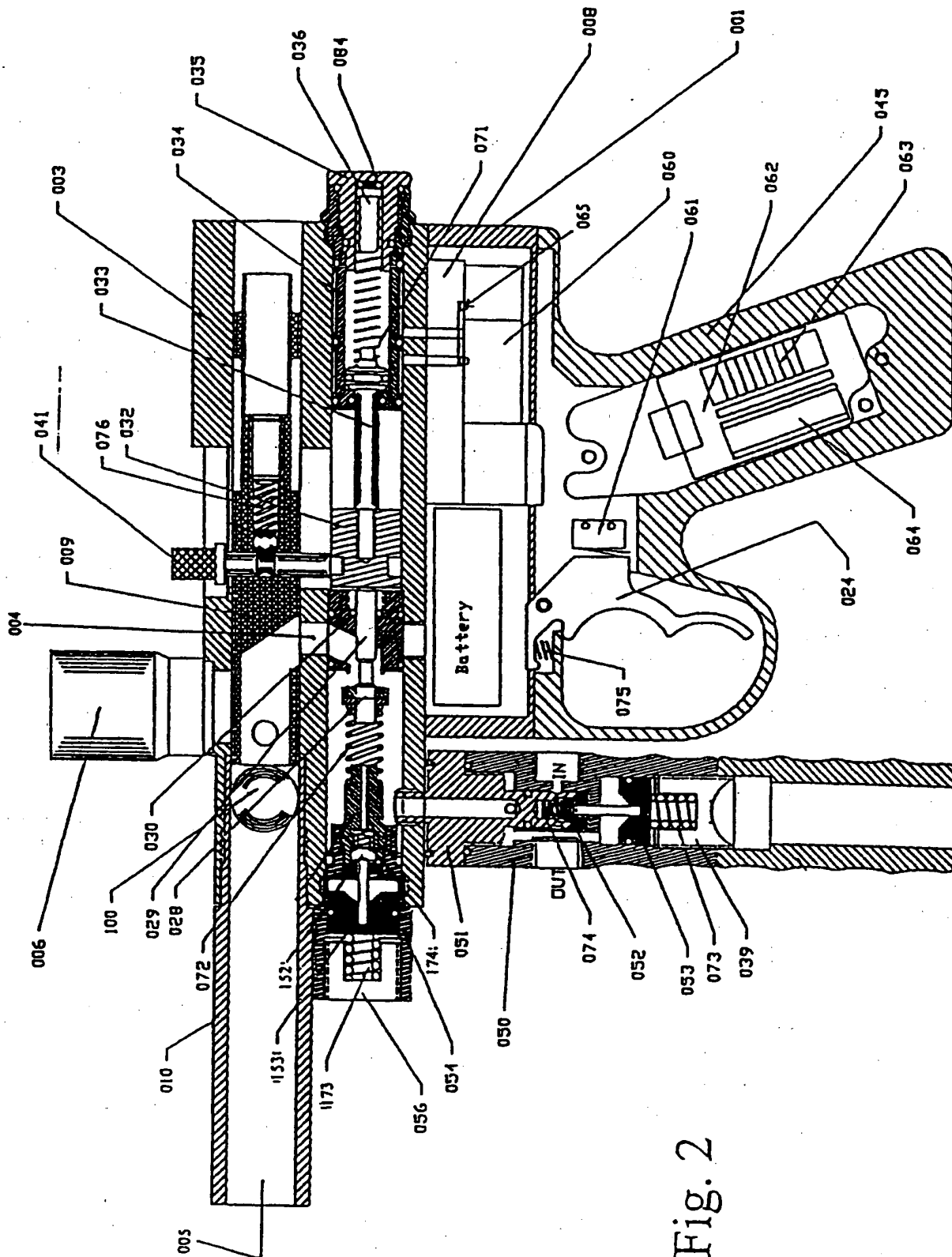


Fig. 2



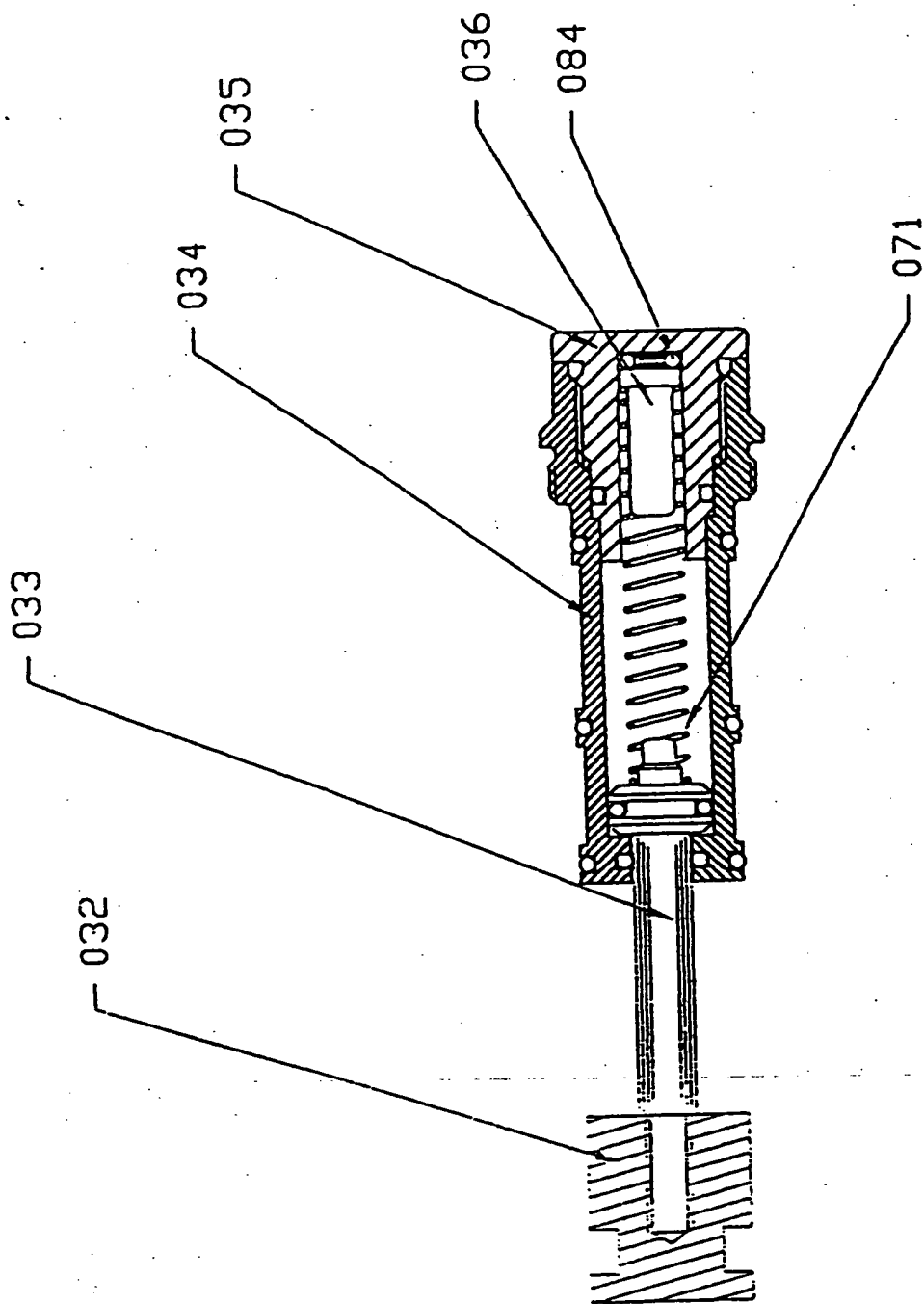


Fig. 3

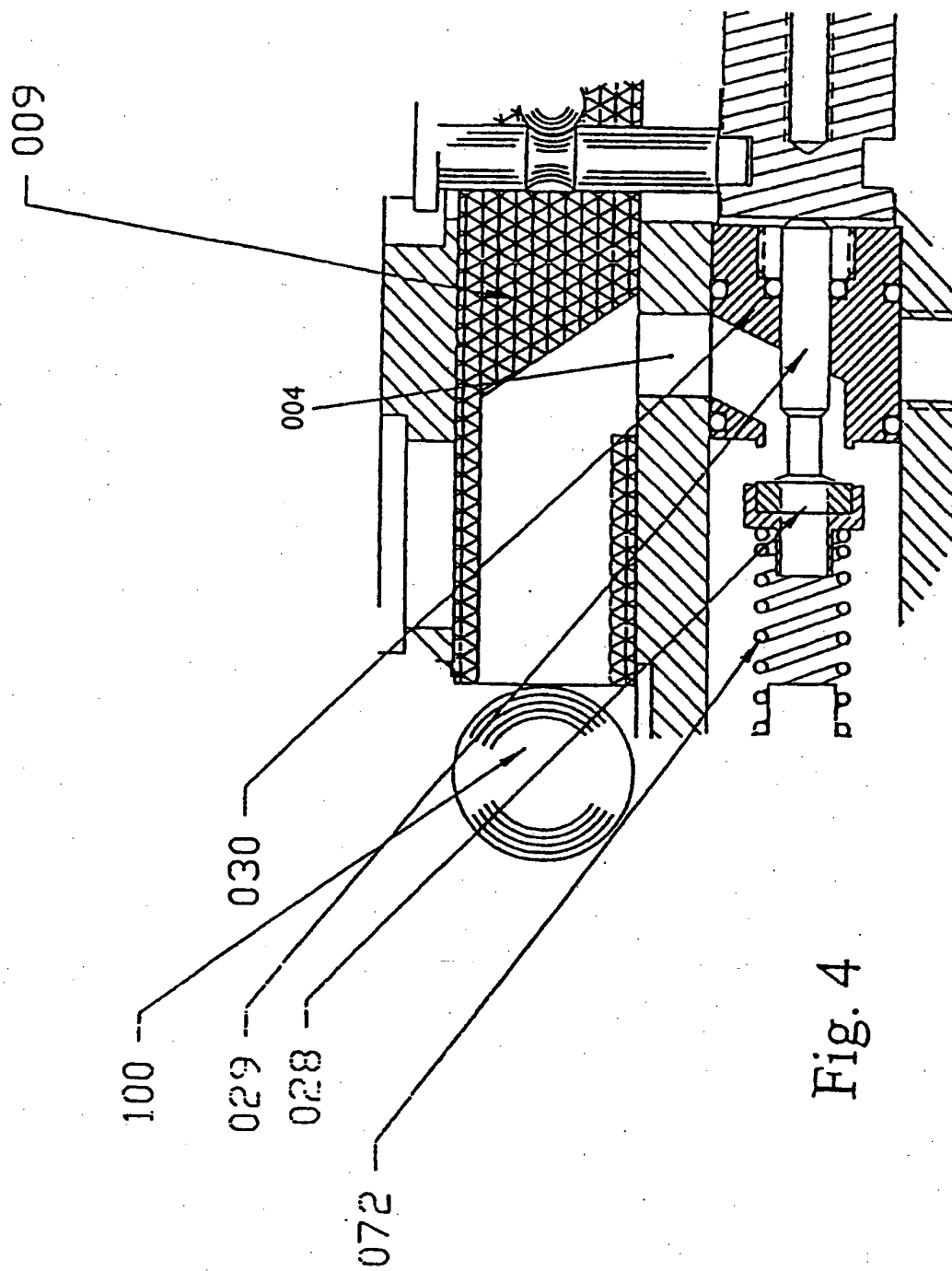


Fig. 4

# INTERNATIONAL SEARCH REPORT

Int'l Application No  
PCT/US 00/15877

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 F41B11/02 F41B11/32

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 F41B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 00635 A (LOTUACO NICANOR D III ;BRASS EAGLE INC (US)) 7 January 1999 (1999-01-07) the whole document	1,2,6,7, 11,12
A	US 5 063 905 A (FARRELL KENNETH R) 12 November 1991 (1991-11-12) column 7, line 61 -column 8, line 5; figures 1-10 column 9, line 45 -column 11, line 30	1,2,6,7, 11,12
A	US 2 554 116 A (R. MONNER) 22 May 1951 (1951-05-22) the whole document	1,2,6,7, 11,12
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

14 September 2000

Date of mailing of the international search report

22/09/2000

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Van der Plas, J

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 00/15877

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 462 042 A (GREENWELL ANDREW J) 31 October 1995 (1995-10-31) column 3, line 52 -column 4, line 26; figures 1-6 column 5, line 28-38 column 6, line 1-32	1,2,6,7, 11,12
P,A	US 6 003 504 A (MARKS NICHOLAS JOHN ET AL) 21 December 1999 (1999-12-21) the whole document	1,2,6,7, 11,12

# INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/US 00/15877

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US 5462042 A	31-10-1995	NONE	
US 6003504 A	21-12-1999	NONE	

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